

## TRIPURA



## GAZETTE

*Published by Authority*

## EXTRAORDINARY ISSUE

*Agartala, Friday, October 13, 2023 A. D., Asvina 21, 1945 S. E.*

**PART--I-- Orders and Notifications by the Government of Tripura,  
The High Court, Government Treasury etc.**

**GOVERNMENT OF TRIPURA  
HOME DEPARTMENT**

No.F.47(2)-PD/2014/2929

Dated, Agartala, the 10th October, 2023.

**NOTIFICATION**

In exercise of the powers conferred by the proviso to Article 309 of the Constitution of India, the Governor of Tripura hereby makes the following rules regulating the method of recruitment and educational & other qualification required for recruitment to the post of **Senior Scientific Assistant (Physical/Chemical/Biological discipline)** in the State Forensic Science Laboratory/District Mobile FSLs, Tripura under Home Department, namely:-

1. **Short title & commencement:-**
  - (i) These rules may be called the Senior Scientific Assistant (Physical/Chemical/Biological discipline) Recruitment Rules, 2023.
  - (ii) They shall come into force on the date of their publication in the Official Gazette.
2. The name of the post shall be as specified in Column-1 of the Schedule annexed hereto.
3. **Number, Classification and scale of pay:**  
The number of the said post, its classification and the scale of pay attached thereto shall be as specified in Column 2 to 4 of the said Schedule.
4. **Method of recruitment, age limit, qualification etc:**  
The method of recruitment to the said post, age limit, educational qualifications and other matters relating to the said post shall be as specified in columns 5 to 13 of the said schedule.
5. **Disqualification :-** No person.

(a) who has entered into or contracted a marriage with a person having spouse living:

OR

(b) who, having a spouse living, has entered into or contracted a marriage with any person, shall be eligible for appointment to the said post:-

Provided that the State Government may, if satisfied that such marriage is permissible under the personal law applicable to such person and the other party to the marriage and that there are other grounds for so doing, exempt any person from the operation of these rules.

6. **Power to relax:-**

Where the State Government is of the opinion that it is necessary or expedient to do so, it may, by order, for reasons to be recorded in writing and in consultation with the Tripura Public Service Commission, may relax any of the provisions of these rules with respect to any class or category of persons.

7. **Repeal and Saving:-**

(i) The Rules namely Senior Scientific Assistant (Physical/Chemical/Biological Discipline), State Forensic Science Laboratory, Tripura under the Home Department issued vide Notification No.F.47(2)-PD/2014/721 dated 20.03.2017 is hereby repealed.

Provided that, any appointment made or order issued, action taken or anything what so ever done, under the rules so repealed, shall be deemed to have been made, issued, taken or done under the corresponding provisions of these rules.

(ii) Nothing in these rules shall effect reservations, relaxation of age limit and other concessions required to be provided for the Scheduled Castes, the Scheduled Tribes, Ex-servicemen and other special categories of persons in accordance with the orders issued by the State Government from time to time in this regard.

8. **Interpretation:-**

If any question arises as to the interpretation of these rules, it shall be referred to the Home Department, Government of Tripura, whose decision thereon shall be final.

By order and in the name of the Governor,

  
(S. Chakraborty)  
Deputy Secretary to the  
Government of Tripura

## S C H E D U L E

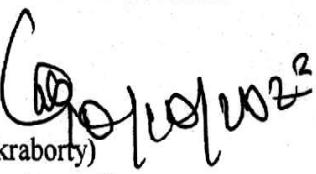
1.	Name of the post(s):	Senior Scientific Assistant, Group-C, Non-Gazetted. <u>Biological Discipline</u> (Biology/Serology/DNA Typing division), State Forensic Science Laboratory and District Mobile FSLs, Udaipur/Kailashahar. <u>Chemical Discipline</u> (Chemistry/Toxicology/Document division), State Forensic Science Laboratory. <u>Physical Discipline</u> (Physics/Ballistics division), State Forensic Science Laboratory and District Mobile FSLs, West Tripura District / Dhalai District.
2.	Number of post(s):	10(ten) plus additional post(s) as and when created.
3.	Classification:	Group-C (Non-Gazetted).
4.	Scale of pay:	Rs. 27,300/- of Level-9 of Tripura State Pay Matrix-2018 subject to revision by the State Government from time to time.
5.	Method of recruitments whether by direct recruitment or by promotion or transfer on deputation and percentage of the vacancies to be filled by various methods:	<p>(i) 50% by promotion.</p> <p>(ii) 50% by direct recruitment on the basis of competitive examination to be conducted by Tripura Public Service Commission (TPSC).</p> <p>In case of direct recruitment by TPSC, selection is to be made on the basis of written examination followed by interview in which the marks distribution for written test and interview have been made as per the New Recruitment Policy for Group-C posts under administrative control of Govt. of Tripura notified vide letter No.F.20(1)-GA(P&amp;T)/18 dated 05.06.2018 &amp; 17.02.2021 and as revised by the Government from time to time. Scheme of examination for recruitment along with the syllabus and marks distribution for written examination (at least 85%) &amp; interview (maximum 15%) are enclosed in <b>Annexure A, B &amp; C</b> for Biological, Chemical &amp; Physical discipline respectively.</p> <p>(iii) No. of written qualified candidates called for interview as per TPSC norms.</p> <p>(iv) Candidates must have appeared in the interview for final recommendation.</p> <p>(v) Final selection will be made on merit list after adding the marks of written and interview.</p>
6.	Age limit for direct recruitment:	Age not less than 18 years and not more than 40 years. Relaxable by 05 years in case of ST/SC/PH candidates and Government servants.

7.	Educational and other Qualification required for direct recruitment:	<p><b><u>Essential:-</u></b></p> <p><b>(i) For Biological Science Discipline:</b> B.Sc. with 45% marks in Botany/Zoology/Microbiology/Biotechnology/Bio-chemistry or Physical Anthropology or Forensic Science or Genetics with Botany or Genetics from any UGC recognized University.</p> <p><b>(ii) For Chemical Science Discipline:</b> B.Sc. with 45% marks in Chemistry/Bio-Chemistry/Forensic Science from any UGC recognized university.</p> <p><b>(iii) For Physical Science Discipline:</b> B.Sc. with 45% marks in Physics/Mathematics/Forensic Science from any UGC recognized University.</p> <p><b>Note:-</b> Permanent Resident Certificate of Tripura (PRTC) would be required while applying for jobs by direct recruitment under the State Government, Corporations, Boards, PSUs etc.**</p> <p><b><u>Desirable:-</u></b> Knowledge of Bengali or Kokborok.</p>
8.	Whether age and Educational qualification prescribed for the direct recruitment will apply in case of promotion:	Age - No Educational qualification - Yes.
9.	Whether Selection post or Non-selection post:	Selection.
10.	Period of probation, if any:	2(two) years.
11.	In case of recruitment by promotion / deputation / transfer, grades from which promotion / transfer / deputation is to be made.	Promotion from the post of Scientific Assistant of Tripura State Forensic Science Laboratory/District Mobile FSLs who has completed 07(seven) years of service in the grade.
12.	If a D.P.C exists, what is its composition:	Group-C, D.P.C.
13.	Circumstances in which TPSC is to be consulted in making recruitment.	As required under the Tripura Public Service Commission (Exemption from Consultation) Regulations, 1973.

14. Répeal	The existing Recruitment Rules for the post of Senior Scientific Assistant (Physical/Chemical/Biological discipline), Tripura State Forensic Science Laboratory vide Notification No.F.47(2)-PD/2014/721 dated 20.03.2017 is hereby stand repealed.
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\*\* Inserted as per Notification vide No.F.23(8)-GA(P&T)/2023 dated 07.07.2023 of the Govt. of Tripura

By order and in the name of the Governor

  
(S. Chakraborty)  
Deputy Secretary to the  
Government of Tripura

**Annexure-A**

**SCHEME OF EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC ASSISTANT (BIOLOGICAL DISCIPLINE), STATE FORENSIC SCIENCE LABORATORY, TRIPURA**

Full marks: 150

Marks allotted for Interview: 12

Proficiency knowledge in Bengali/Kokborok: 3

Marks allotted for written Test: 135

Pattern of questions for written Test: Multiple Choice Question (MCQ)

There will be Negative mark for MCQ.

Distribution of marks for written Test:

<b>Sl. No.</b>	<b>Items</b>	<b>Marks allotted</b>
1	English Language	20
2	General knowledge	15
3	Subject matter (Biological Discipline)	100

**(1) Syllabus for English Language:** Question on English language will cover Synonyms, Antonyms, use of common Phrase & Idioms., use of appropriate Prepositions and Articles, Comprehension, Ordering of words in a sentence , Ordering of sentences, spotting of errors, use of appropriate and qualifying words etc.

**(2) Syllabus for General Knowledge:** General knowledge with special reference to Tripura and North Eastern States

**(3) SYLLABUS FOR SUBJECT MATTER (Biological Discipline):**

**Fundamentals of Forensic Science and Scope of Forensic Biology:** Definitions, History and Development.

Legal & Court Procedure pertaining to Expert Testimony, Admissibility of Scientific & Technical evidence- 293 Cr.P.C.

**Tools and Techniques:** Microscopy- Basic principles and working of simple and compound, comparison, phase-contrast, stereo-zoom, polarizing, Fluorescence, Scanning Electron & transmission electron microscope and U.V. light sources, Centrifuge, Electrophoresis.

**Immunological techniques:** General principles, Precipitin reaction, Gel immune-diffusion, Immuno-electrophoresis, Radio Immuno Assay , ELISA, Immune system, immune response, innate and acquired immunity, antigens, antibodies, Immunoglobulins, raising of anti-sera, Lectins -their forensic significance. Buffers and biological reagents, Methods of sterilization employed for biological work.

**Biosystematics & Taxonomy:** Chemotaxonomy, Cytotaxonomy, Molecular Taxonomy and General classification of Animals.

**Human Anatomy & Physiology :**

Cell structure and function: Membrane structure and its role in transportation. Cell organelles and Cell Division. Basic structure of DNA and RNA. Protein Synthesis, karyotyping. Sex Chromosomes/sex chromatin. Abnormal cell growth and tumors.

**Introduction to Body Function:** External and internal environment, homeostasis. Negative and positive feedback mechanism.

**Structure and function of the major organ systems :** digestive, skeleton, respiratory, endocrine, nervous, excretory, reproductive, cardiovascular and neuromuscular. Mode of communication within the body. Importance of electrolytes, acids and alkalis, carbohydrates, proteins and fats in the body.

**Tissues of the body:** Epithelia and glands. Classification of epithelia/glands and their functions. Connective tissues. Cartilage- structure and types, Gross structure of bones, formation of bone, fracture and healing.

**Skin and its appendages:** Structure and functions, pigmentation, blood and nerve supply. Structure of hair, Sebaceous glands, nails, sweat gland. Skeletal muscle, striated and non-striated, muscle. Organization of muscle fibres. Tendons and Nerves.

**Body Fluids & their stains:** Introduction to various types of body fluids, Composition, Physical pattern and Identification of seminal stains: Morphological structure of spermatozoa of human and animals, Identification and examination of other body fluids/stains—vaginal, saliva, urine, faeces, vomit etc.,

Identification and examination of body tissues of human/animal.

**Forensic Anthropology:** Personal identification techniques as somatoscopy and somatometry. Anatomical description of skeleton of human/animal as relevant to forensic, Ossification & Identification of bones for determination of age, sex, race, stature etc., Forensic Anthropometry/Osteometry and tools involved in it. Determination of personal identity, Sex differences in skull, Pelvis and other bones.

**Facial reconstructions & Superimposition:** Cranio facial superimposition techniques as Photographic & Video superimposition.

**Forensic Odontology:** Dentition pattern, types, structure and growth of teeth, eruption sequence, age determination, identity of person, role in mass disaster, dental anomalies and their significance in personal identification.

Bite marks analysis of human/animal.

**Hair and Fibres :** Morphology and Biochemistry of human/animal hair, determination of origin, race, sex and site.

**Types and Identification of Fibres:** Man-made and Natural fibres and its Forensic significance.

**Forensic Botany :** General plant classification schemes. specialisation of forensic botany morphology, anatomy, systematic, ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes:- vegetables/herbs, fruit bearing trees and plants, trees, shrubs and grasses, plant cell structure and functions.

**Basic plant tissues. Wood anatomy:** Various types of woods, timbers, seeds and leaves and their forensic importance. Xylotomy-types of sections, staining and preparation of slides. Identification and matching of various types of wood, seeds and leaves.

**Planktonic study:** Various types of phytoplankton, diatoms and their forensic importance. Different kinds of diatoms and their morphology

**Forensic Palynology:** Study and identification of pollen grains and its forensic importance. Narcotics, poisonous and alkaloid plants : Morphology and anatomy of plants, types of plants yielding drugs of abuse – opium, cannabis, coca, tobacco. Identification of plants of Cannabis sativa (Ganja & bhang) , opium (Papaver somniferum), tobacco (Nicotiana tabacum) etc. in criminal cases.

**Forensic Microbiology:** Isolation, classification and identification of microbial organism, cell structure of bacteria and fungi, their spores, microbes of soil and spoiled food, microbial organism related to sexual transmitted disease,

**Forensic Environmental Biology:** Different kind of ecosystems, effects of pollution in aquatic habitat, identification of Algal bloom and their composition, Eutrophication and their effects, Identification methods for coliform bacteria , BOD (biological oxygen demand).

**Wild life Forensics:** Wild life, Importance of protected and endangered species of Animals and Plants. National and International scenario of wild life, Sanctuaries and National parks. Relevant provision of wild life and environmental act.

**Forensic Entomology:** Introduction, History, Significance, Classification and Biology of insects and other arthropods, Life cycle and forensic application of insects, determination of time since death (postmortem interval i.e. PMI) - Dipterans larval development & succession on carrion and its relationship to determine time of death, impact of ecological factors on insects developments, rearing insects & calculating PMI, identification of larval instars, determining whether the body has been moved, linking suspect to the scene,

**Forensic Genetics:** Elements of human genetics- Introduction, principles of heredity, human genetic variations, human chromosomes, chromosomal aberration, Mendelian, Dominant, recessive and sex-linked inheritances, polymorphic traits. Heritable human diseases. Metabolic/molecular basis and detection of inherited disease, Mendelian Population, gene pool, Hardy-Weinberg equilibrium and deviation, genotypes, phenotypes, multiple alleles, genetic variants, gene structure, gene mapping and gene Expression. Genetic markers and their forensic significance. Mutation – Classification, causes, mechanism, role of genetic analysis and evolution. Structure of DNA, functions and its properties, Human genome, History of DNA fingerprinting, Polymerase chain reaction, types and it's application, mitochondrial analysis, determination of sex & species and racial origin.

**Annexure-B**

**SCHEME OF EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC ASSISTANT (CHEMICAL DISCIPLINE), STATE FORENSIC SCIENCE LABORATORY, TRIPURA**

Full marks: 150

Marks allotted for Interview: 12

Proficiency knowledge in Bengali/Kokborok: 3

Marks allotted for written Test: 135

Pattern of questions for written Test: Multiple Choice Question (MCQ)

There will be Negative mark for MCQ.

Distribution of marks for written Test:

Sl. No.	Items	Marks allotted
1	English Language	20
2	General knowledge	15
3	Subject matter (Chemical Discipline)	100

**(1) Syllabus for English Language:** Question on English language will cover Synonyms, Antonyms, use of common Phrase & Idioms., use of appropriate Prepositions and Articles, Comprehension, Ordering of words in a sentence, Ordering of sentences, spotting of errors, use of appropriate and qualifying words etc.

**(2) Syllabus for General Knowledge:** General knowledge with special reference to Tripura and North Eastern States

**(3) SYLLABUS FOR SUBJECT MATTER (Chemical Discipline):**

**1) Structure of atom :** atomic spectra of H atom, Bohr's atomic model and its limitations, Sommerfeld model, Black body radiation, Planks equation, Qualitative idea of Photoelectric effect and Compton effect, wave particle duality, de-Broglie matter wave, Heisenberg's uncertainty principle, Schrodinger's wave equation for one electron system , shape of s,p,d orbital, quantum number and significance, Pauli's exclusion principle and Hund's rule, energy order of orbitals, Aufbau principle and its limitations electronic configuration of atoms (up to Z= 30).

**2) Statistical treatment of data analysis:** accuracy and precision, classification of errors, detection and correction of determinant and indetermination errors, rejection of data, significant figure.

**3) Redox reactions:** Ion electron method of balancing equations , calculation of equivalent weight of oxidants and reductants, standard electrode potentials, formal potentials, electro chemical series, redox potentials and its applications, choice of indicator in redox titrations.

**4) Chemical Bonding:** (a) Ionic bonding: Types of ionic solids, radius ratio effect, limitation of radius ratio rule, concept of lattice energy, Bond-Land equation, Born-Haber cycle, solvent energy and solubility of ionic solids, ionic potential, polarizing power, polarizability of ions and Fajan's rule.

(b) Covalent bonding: Basic idea of Valance Bond theory and its limitation, concept of Hybridizations of orbitals, sigma and pi- bond, Bents rule, VSEPR theory and its application to shapes of different molecule and ions e.g.  $\text{BF}_3$ ,  $\text{NH}_3$ ,  $\text{NH}_4^+$ ,  $\text{H}_2\text{O}$ ,  $\text{PCl}_5$ ,  $\text{SF}_4$ ,  $\text{XeF}_2$ ,  $\text{XeF}_4$ , etc. formal charge, polarity of covalent bond and dipole moment, percentage of ionic character of covalent bond.

5) (a) **The Gaseous state:** The gas law, postulate of kinetic theory of gases, gas pressure, kinetic theory of gas equation  $PV=1/3 mnc^2$  deduction of gas laws, average kinetic energy of molecules, mean free path, collision diameter, collision number, collision frequency, their dependence on temperature and pressure, heat capacity of gases, atomicity of molecule, viscosity of gases. (b) Deviation from ideal behavior, Regault, Andrews and Amagat experiments causes of such deviations, compressibility factor, Vander Walls equations, critical phenomenon, critical constant, and laws of corresponding states. Maxwell distribution law of molecule, Velocities (no derivation), most probable, average and root mean square velocities – their relationship.

6) **Solution properties:** Physical properties of liquids including their experimental methods of determination, types of solutions, ideal and non-ideal solutions, modes of expression of composition of solutions- molarity, molality, normality, mole fraction and percentage, solutions of gases in liquids, Henry's law, surface tension, viscosity, extensive and intensive properties, constitutive and colligative properties, Raoult's law of relative lowering of vapour pressure, elevation of boiling points, depression of freezing points, osmosis- laws of osmosis. **General features of solution**, types of solution, ideal and non-ideal solutions, molarity, molality, normality, mole fraction and percentage, sol of gases in liquids, Henry's law.

7) **Periodic Properties:** Modern periodic table, classification of elements on the basis of electronic configuration, periodic variation in properties- atomic and ionic radii, oxidation states, ionization potential, electron affinity, electronegativity (Mulliken scale, Pauling Scale), diagonal relationship.

A) s- and p-block elements: The oxides and hydroxides of alkali and alkaline earth elements, boron hydrides, silicates, silicones, oxyacid's of Sulphur. (B) d- block elements: First row transition series: (3d) electronic configuration, oxidation states, reactivities, colour and magnetic properties.

(C) Preparation, properties and structure of the following compounds.--Potassium ferro and ferricyanide, lithium aluminium hydride, sodium cobaltinitrite, Nessler's reagent, sodium borohydride, ferrocene, sodium nitroprusside.

D) f- block elements: Electronic configuration of Lanthanides and actinides, comparison of their oxidation state, variation of their atomic and ionic radii, lanthanide contraction. Preparation and important reactions, structures and uses of nickel tricarbonyl, sodium nitroprusside, sodium cobaltinitrate, potassium ferrocyanide, potassium ferricyanide, potassium dichromate, potassium permanganate, cupric acetate and Ziese's salt.

8) **Acid-Base concept:** Arrhenius concept, Bronsted-Lowry concept, Lewis concept, solvent dependence of acidity and basicity, ionic product of water, The pH scale, buffer solution, Hard and soft acids and base and their classifications, acid-base and hardness and softness, symbiosis.

9) **Covalent bonding :** Basic idea of VBT and its limitations, Concept of hybridization of orbital, Bent's rule, VSEPR theory, and its application of molecules and ions, -  $\text{BeF}_2$ ,  $\text{BF}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{PCl}_5$ ,  $\text{SF}_4$ ,  $\text{XeF}_2$ ,  $\text{XeF}_4$ ,  $\text{XeOF}_4$ , formal charge, polarity and dipole moment, percentage of ionic character of covalent bond.

**Bonding in metals**, semiconductors and Hydrogen bond- Theory, and basic concepts, free electron theory and bond theory in solids, elementary idea on semiconductors and concepts and types of H bonding. Covalent bonds- basic concepts of VBT and its limitations, resonance and resonance energy, hybridizations involving s, p, d and sigma and pi bonds.

**10) Gaseous state** – gas laws, postulates of kinetic theory of gases, gas pressure, kinetic theory of gas equation, deduction of gas laws, average kinetic theory of molecules, mean free path, collision diameter, collision number, collision frequency and its dependence on tem and pressure. Basic concepts and theory of Real gases, its deviation from ideal behavior, different experimental cause of such deviations, compressibility factor, critical phenomenon, Maxwell distribution, law of molecular behavior.

**The liquid state** – Physical properties of liquids, including the experimental method of determination of internal pressure, vapor pressure, surface tension, and viscosity, effect of temperature and on those properties.

**Crystalline state** – laws of crystallography, Weiss and miller indices , seven crystal system, crystal packing, radius ratio, co ordination number, X ray diffraction.

**11) Thermodynamics** – thermodynamic system, surrounding, various types of systems and processes, isothermal, isobaric, isochoric processes, reversible and irreversible , adiabatic, cyclic etc processes, thermodynamic parameters, perfect and imperfect differentials, thermodynamic law- Zeroth law.

First law, mathematical relation, internal energy, Joules experiment, relationship between  $C_p$  and  $C_v$ , Kirchhoff's equation, calculation of change of in thermodynamic parameters for expansion, compression of an ideal gas under various conditions for reversible irreversible process. Joule Thomson effect, second law of thermodynamics, need of the law, spontaneous process, Carnot cycle, engine efficiency of heat engine, concept of entropy, entropy change in simple systems, physical significance of entropy, Nernst heat theorem., third law of thermodynamics.

**12) Chemical kinetics**- order and molecularity of reactions, rate of reactions, rate law and rate equations, differential and integral forms of rate equation, zero order, first order and second order of reactions, half life and average life, experimental methods for the determination of order of reactions, effect of temperature on rate of reactions, Arrhenius concept collision theory and transition state theory of reaction rates and their comparison.

**13) Chemical equilibrium** – Reversible and irreversible reactions, law of mass action, derivation of expression for equilibrium constant for homogeneous and simple heterogeneous system, Le-Chatellier principle, simple applications, inter relationship between  $K_p$ ,  $K_c$  and  $K_x$  , characteristic of equilibrium state.

**14) Co-ordination chemistry**- Werner's theory, IUPAC nomenclature of different types of ligands, multidentate ligands, coordination number and stereochemistry (up to coordination no-6), chelates, inner metallic concepts, types of isomerism and bonding in co ordination compounds, double salt& their applications, MOT  $H_2$ ,  $N_2$  &  $O_2$ .

**15) Magnetochemistry** – Concept of diamagnetism, Para magnetism, ferromagnetism, origin of paramagnetic moment, electron spin moment, and orbital angular moment, magnetic susceptibility and magnetic moment measurement of magnetic susceptibility, Curie law, Curie-Weiss law, explanation of magnetic behavior of some common complex compounds.

**16) Bio inorganic chemistry** – Some basic concepts of cell membrane, membrane transport, essential and trace elements in human beings, and their involvement in Biological process, pH of a biological fluid, structure and functions of hemoglobin, Non complexing cations in Biological process,

**Macromolecules** – different types of macromolecules, degree of polymerization, molar mass, determination of molar mass by viscometry.

**Photochemistry**- introduction of radiation with matter, comparison of dark(thermal) and photochemical reactions, idea of phosphorescence, fluorescence, luminescence, laws of

photochemistry, Lamberts law, beers law, photochemical equilibrium, photosensitized reactions, photochemistry of air and air pollution.

**17) Inorganic based Industrial chemistry** – Modern methods of water treatment and water purification, idea of water pollutants, basic concepts of different types of common fertilizers and preparation and some idea of their common analytical techniques.

**Glass** – different types of glass, fibres, opticalfibre, glazing and vitrification, glass ceramics, **Cement** – various types of cement, composition, manufacture and their analysis.

**Paints** – constituents of different types of paints, role of binder and solvent in paint, lead and zinc containing paints, paints of common use.

**Metals and alloys** –general procedure of extraction of metals, manufacture, properties and composition of different types of alloys , steel and stainless steel, galvanization , corrosion.

**18) Drugs and pesticides and Toxicology** – introduction, classification of drugs, difference between drug and medicine, preparation and use of aspirin, sulphanilamides, diazepam., Introduction and classification of pesticides, natural and synthetic pesticides, preparation and sue of DDT, eldrin, Malathion, parathion, and baygon. Metal poisoning due to lead, mercury, cadmium, and common pesticidal and insecticidal poisoning. Some basic concepts of extraction, analysis and determination of poisons from biological substances with special reference to human viscera.

**19) Spectroscopy– UV and visible spectroscopy**, Introduction, theory and instrumentation, solvent effects, characteristic of absorption of organic compounds, application and rules for calculation of  $\lambda_{max}$ .

**Infrared spectroscopy** – Introduction, theory and instrumentation, characteristic group frequencies of organic compounds. Factors affecting the group frequency.

**Mass spectroscopy** - Introduction, theory and instrumentation, charaterisristics of obtaining different m/z values and factors affecting it.

**20) Chemistry in applications** – Dyes- colour and constitution, chromophore, auxochrome, VBT of color, (UV and absorption spectra), classification of dye, preparation and use of come common dye as phenolphthalein, methyl orange, Congo red, alizarin, fast blue b and indigo.

**21) Organic chemistry** : Introduction, occurrence, classification, inter relationship between mono saccharides, constitution of glucose and fructose, ribose and arabinose, reactions of glucose and fructose, osazone formation, mutarotation and its mechanism, cyclic structure, pyranose and furanose form, determination of ring size, hawarth projection formulae, interconversion of aldose and ketones.

**Hetrocyclic compounds** : Introduction, five and six member heterocycles, aromatic character, nomenclature, structure, synthesis and chemical reactivity of furan, pyrrole, thiophene, pyridine, basicity of pyrrole and pyridine, introduction to condensed five and six membered heterocycles, synthesis and reactivity of indole, quinoline and isoquinoline with special ref to Fischer Indole synthesis,

Concepts on reaction intermediates, (carbocation's, carbanions, carbines, arynes, nitrenes)

Synthesis, application of active methylene compounds and organometallic reagents preparation and application of Grignards reagent and synthetic application of Grignards reagent, Oragnolithium and organocopper reagents.

**Rearrangement reactions:** Pinacol Pinacolone, Dienone-phenol, Beckmann, Wolff , Hoffman, Schimdt, Fries and Claisen, Demjenov and Favorskii rearrangement.

**Important reactions of aliphatic compounds with mechanisms-** Corey house synthesis, addition of hydrogen halides, ozonolysis, hydroboration oxidation, catalytic hydrogenation of alkenes, Alkynes – acidity, Birch reduction of alkynes, , Alcohols- dehydration oxidation, pinacolpinacolone rearrangement, carbonyls- Oppenauer oxidation, MPV reduction, Rosenmund red, Stephen reaction, bayerVilleger oxidation, Wolf kishner reduction, Aldol and Clsisen condensation, cannizaro reactions.

**Structure, reactivity of organic molecules** – hybridization of organic molecules, bond It, bond angle, bond energy, bond polarity, bond polarizabilty, formation of pi and sigma bond, localized and delocalized chemical bonds, Vander Walls interactions, resonance, tautomerism, steric inhibition of resonance, hyper conjugation, inductive and field effects, H bonding, dipole moment, bond moment and group moment, physical properties related to molecular structures.

**Important reactions with mechanism of aliphatic compounds-** Alkane – free radical halogenations, alkenes – halogenations, hydroxylation, hydrogen halide ozonolysis, hydroboration oxidation, catalytic hydrogenation of alkanes, Alkynes ; acidity, use of Lindlers catalysis, Birch reduction of alkynes, Alcohols : dehydration oxidation, pinacolpinacolone rearrangement, Stehen reduction, bayer Villeger oxidation, Wolf Kishner reduction, Stephen reaction, bayer Villeger oxidation, Wolf kishner reduction, Aldol and Clsisen condensation, cannizaroreactions.

**22) Inorganic qualitative analysis-** from salt mixture, and from heterogeneous mixture comprising of biological substances. Basic concepts of volumetric titrations-Basic concepts of Inorganic Quantitative analysis- Inorganic preparations and crystallizations-

Practical concepts of determination of specific gravity, surface tensions, viscosity, partition coefficients of a mixture,

**22) Organic qualitative analysis-** identification of pure compounds from a heterogeneous mixture, determination of mp, solubility, determination of special element, determination of functional groups, preparation of derivatives, basic concepts of Thin Layer Chromatography, determination of  $R_f$  value on TLC and survey of literature,

Basic concepts of chromatography, spectroscopy, and their applications in Forensic science. And concepts on all other practical analysis done at B Sc level.

**23) Forensic Chemistry:** Some basic concepts of forensic chemistry and the applications of basic chemistry knowledge in chemical examination of crime case exhibits.

**Annexure-C**

**SCHEME OF EXAMINATION FOR THE POST OF SENIOR SCIENTIFIC ASSISTANT  
(PHYSICAL DISCIPLINE), STATE FORENSIC SCIENCE LABORATORY, TRIPURA**

Full marks: 150

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**(2) Syllabus for General Knowledge:** General knowledge with special reference to Tripura and North Eastern States.

**(3) SYLLABUS FOR SUBJECT MATTER (Physical Discipline):**

**Unit-I:**

Vectors: Vector algebra. Scalar and vector products.

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's Theorem of vectors

Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass

**Momentum and Energy:** Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

**Rotational Motion:** Angular velocity and angular momentum. Torque. Conservation of angular momentum.

**Gravitation:** Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness.

**Oscillations:** Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

**Elasticity:** Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion - Torsional pendulum-Determination of Rigidity modulus and moment of inertia -  $q$ ,  $\eta$  and  $\sigma$  by Searle's method.

## **Unit-II:**

**Electrostatics:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss Theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

**Magnetism: Magnetostatics:** Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. **Magnetic properties of materials:** Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

**Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance,  $L$  of single coil,  $M$  of two coils. Energy stored in magnetic field.

**Maxwell's equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves.

### **Unit-III**

**Laws of Thermodynamics:** Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between  $CP$  &  $CV$ , Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Third law of thermodynamics, Unattainability of absolute zero.

**Kinetic Theory of Gases:** Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

**Theory of Radiation:** Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law

Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method.

Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication.

Sound: Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films, Newton's Rings: measurement of wavelength and refractive index.

Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit.

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

#### **Unit-IV:**

Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson Germer experiment.

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra.

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy.

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life;  $\alpha$  decay;  $\beta$  decay - energy released, spectrum and Pauli's prediction of neutrino;  $\gamma$ -ray emission.

Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor, Fusion and thermonuclear reactions.

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability.

Radioactivity decay:(a) Alpha decay: basics of  $\alpha$ -decay processes, theory of  $\alpha$ emission, Gamow factor, Geiger Nuttall law,  $\alpha$ -decay spectroscopy. (b)  $\beta$ -decay: energy kinematics for  $\beta$ -decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe Block formula), energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.

**UNIT-V:** Digital Circuits Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by Sum of Products Method

Binary Addition. Binary Subtraction using 2's Complement Method). Half Adders and Full Adders and Subtractors,

Semiconductor Devices and Amplifiers: Semiconductor Diodes: p and n type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell. Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. Current gains  $\alpha$  and  $\beta$ . Relations between  $\alpha$  and  $\beta$ . Load Line analysis of Transistors. DC Load line and Qpoint.

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop & Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator,

Sinusoidal Oscillators: Barkhausen's Criterion for Self-sustained Oscillations. Determination of Frequency of RC Oscillator

Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation.